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# Prioritisation of Road Pavement Type Selection with Analitycal Hierarchy Process (AHP) Method on Palu City Road Rehabilitation Work Packages

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**Abstract:- Policy conditions and budget politics greatly affect the determination of sections and pavement types by road organisers, the number of proposed road improvements each year is not proportional to the amount of budget available. This greatly affects the determination of pavement types, where road organisers will choose a more economical pavement type that adapts to the available budget to meet these interests, although technically it will have an impact on not achieving the planned life which results in high maintenance costs. This study specifically tries to apply the AHP (analytic hierarchy process) method in the interest of formulating and making decisions in prioritising the selection of pavement types. It is hoped that through this study it can be proven that the AHP method can help policy makers, especially within the scope of local government, o make decision making more objective.The methods of this study include data collection methods and analysis methods. In this study, a questionnaire was used to collect data, involving respondents who have more than 10 years of experience and are considered experts in the field of roads and bridges. Based on the analysis of the order of the priority weight of the criteria for the priority selection of the type of pavement, namely the technical criteria has the highest weight of 0.344, Furthermore, the policy criteria have the second highest weight value with a weight value of 0.247, in third place is the cost criteria with a weight value of 0.230 and the last is the implementation criteria with a weight value of 0.178. The order of alternative types of pavement for road rehabilitation in the city of Palu is: 1) AC-WC (Asphalt Concret Wearing Course) (19.3%), 2) Macadam Penetration Layer (18.3%), 3) HRS (Hot Roller Sheet) (16.5%), 4) Sand Sheet (16.3%), 5) Composite Pavement (15.4%), 6) Rigid Pavement (14.2%)**

***Keywords:-*** *Road Rehabilitation Budget, Influential Criteria, Alternative Pavement Type Selection.*

## I. INTRODUCTION

One of the major public aspects is roads, as they are the most important means of transport. Proper planning and maintenance operations in terms of time will go a long way in maintaining these facilities. [1] Adverse impacts will arise in the form of repairs (renovation operations) or rebuilding (re- restoration) if maintenance is not carried out on time. Even greater costs are often incurred due to lack of maintenance [2]. Pavement is an important part of the road structure, the selection of pavement type is one of the challenges in decision making for road operators. The selection of pavement type is a consideration that must be evaluated objectively[3]. Inappropriate pavement selection will increase construction costs, maintenance costs, road user costs, and can have an impact on environmental and social conditions[4] .

Policy conditions and budget politics greatly affect the determination of sections and pavement types by road operators, the existence of priority proposals from legislative members through the main points of thought by legislative members obtained from the results of recess networking of public aspirations which must be followed up by local device organisation. This is very influential in determining the type of pavement, where road operators will choose a more economical type of pavement that adapts to the available budget to fulfil these interests, although technically it will have an impact on not achieving the planned life which results in high maintenance costs.

Based on basic data on Palu city road infrastructure in 2021, the length of roads under the authority of the Palu City government is 851.55 km consisting of 1,462 road sections, with the type of pavement or surface layer consisting of asphalt concrete wear surface (AC-WC) 45.99%, macadam penetration layer 21.46%, concrete pavement 6.73%, gravel 20.88%, and dirt roads 4.94. Of the 851.55 km, 30.88% are in good condition, 32.81% are in moderate condition, 24.17% are in lightly damaged condition and 12.14% are in severely damaged condition or the value of road stability conditions in Palu city is currently 63.69% (Palu City Government, 2021). This road stability value is

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still far below the national target of 91% in 2021.

## II. LITERATURE STUDY

The pavement layer located between the subgrade and the wheels of the vehicle is referred to as pavement, which has a function to improve the service of transportation facilities so that damage does not occur according to the desired construction plan life. The main factors influencing the improvement of the function of pavement construction should be the main consideration in its planning [5].

Based on its function, roads can be divided into arterial roads, collector roads, and local roads. Arterial roads or main roads are roads that serve the main transport with the characteristics of long distance travel, high speed. While collector roads are roads that can accommodate medium-distance traffic at medium speeds. And local roads are roads that can accommodate short-distance and low-speed traffic [5].

According to Silvia Sukirman [5] so that road pavement construction can provide a sense of security and comfort to road users, the road pavement must meet certain requirements, namely:

### A. *Functional*

The pavement is able to perform a good function for road users. These functions include safety, and ride comfort. These requirements include, among others:

- Flat surface, not bumpy / sloping and not perforated.
- It surface is strong enough so that the pavement surface is not slippery / not easy to skid.
- The surface is easy to drain water, so that rainwater that falls on it can be quickly drained into side channels.

### B. *Struktural*

Pavement is able to carry and transmit traffic loads to the subgrade. The requirements that must be met include:

- Has sufficient thickness, so that it can spread the load / traffic load to the subgrade.
- Impermeable to water, so that water does not easily seep into the underlying layers.
- Pavement is able to withstand stresses and strains due to traffic loads.
- A surface that is rigid enough that it does not deform easily.

➢ *Types of Pavement Construction*

Based on the binder used to form the surface layer, the pavement can be divided into three, namely: Flexible Pavement, Rigid Pavement and Composite Pavement [6]

➢ *Surface Course*

Is the layer that lies at the top commonly called the surface layer, and serves as a pavement layer retaining wheel load, as a waterproof layer, wearing course and as a layer that spreads the load to the lower layers [5].

The types of road surface pavement layers commonly used in Indonesia include One Layer Asphalt Layer, Two Layer Asphalt Layer, Macadam Penetration Layer, Buton Asphalt Aggregate Layer, Asphalt Layer, Asphalt Concrete Layer, Hot Rolled Sheet (HRS), Split Mastic Asphalt (SMA) and Butonite Mastic Asphalt (BMA), [7].

➢ *Road Performance*

In accordance with the function of roads as traffic movement infrastructure, roads can be assessed in terms of their performance quality. Among the things related to performance are durability, economic value, plan life, comfort, flexibility and applicability. Each performance component contributes to the quality of road service to traffic.

- *Endurance*

The durability of a road construction is a measure that indicates a road's ability to maintain its condition from damage and wear due to the influence of external factors such as weather, water, soil movement, traffic changes, etc.

- *Economic Value*

Economic value shows a comparison between costs and benefits. Costs can include procurement or construction costs, maintenance, replacement, etc. While benefits are related to service capacity, service period, etc.

- *Plan Life*

Plan life is the approximate life span of a road service during the period of use. The smaller the plan age indicates the smaller the quality of road service and the greater the plan age indicates the greater the quality of road service.

- *Convenience*

Comfort is a performance measure that is directly perceived by traffic users while using the road. Comfort is generally related to the quality of the surface, as the vehicle is in direct contact with the road surface. The better and smoother the surface, the higher the level of driving comfort.

- *Flexibility*

Flexibility relates to the ease of replacement when damage occurs or the ease of making construction changes when needed. Road construction is said to be flexible if it is easy to repair or replace it without making fundamental changes to the existing construction. Conversely, a road is said to be less flexible if a slight repair or replacement must be followed by fundamental changes to its basic construction.

- *Applicability*

A construction is said to have a high level of applicability if the construction can be applied easily at a location. This is related to ease of implementation, availability of human resources, financial resources, and suitability for the surrounding environment.

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➢ *Road Maintenance*

Road Maintenance is the treatment of roads that includes upgrading, rehabilitation, maintenance, and support. Road maintenance brings direct and sometimes substantial benefits to road users through improved access to hospitals, schools and markets; increased comfort, speed and safety; and lower vehicle operating costs. For these benefits to be sustainable, road improvements must be followed by a planned maintenance programme. Without regular maintenance, roads deteriorate quickly, hindering the realisation of the long-term impact of road improvements on development [1].

Pavement maintenance procedures are considered a cost-effective rehabilitation and maintenance approach to a given pavement system [9].

➢ *Pemeliharaan Yang Dikenal Dan Digunakan Di Indonesia Antara Lain:*

- Routine Maintenance Treatment given only to the surface layer that is to improve riding quality, without increasing structural strength, and is carried out throughout the year.
- Periodic Maintenance Maintenance carried out on the road at certain times (not continuously throughout the year) and its nature is to improve the structural capabilities of the road.
- oad Improvement Road handling to improve road services in the form of structural and or geometric improvements to achieve the planned level of service.

➢ *Criteria*

In the process of making decisions on several alternatives, criteria will be needed. Criteria are part of the aspects of planning, used to solve problems that will ultimately produce answers to questions [10]. In order to provide a sense of security and comfort to road users, pavement construction must meet the criteria in designing pavement [11].

Criteria are used as a measuring tool to measure the level of goal achievement, because criteria show the definition of a problem in a concrete form. Criteria are standards of determination or basic rules by which alternative decisions are sorted according to the wishes of the criteria themselves, or in other words criteria are a general term that includes the concepts of attributes and goals. Factors that affect the feasibility of pavement include technical factors, non-technical factors and costs [12]. Technical factors are the most dominant factors to measure road feasibility [13]. Technical factors include weather resistance, soil movement resistance and traffic resistance. For non-technical factors affecting the feasibility of paving, the maintenance period factor relates to the speed or length of construction that requires repairs. Although the availability of resources is related to the availability of funds. Both non-technical factors indicate that as little maintenance and repair as possible, road construction is considered preferable, and the availability of resources, especially funds, is the determining factor for construction. Funding is always constrained by the availability of Indonesia's road construction budget. Another important factor to consider is the comfort of the road construction surface. This factor is important, as it relates to user comfort after the completion of the construction. In this study, the comfort factor is also supported more than the ease of construction factor. The complexity of the criteria in determining the type of pavement varies, among others: [14].

- Pavement construction cost criteria
- Criteria for the type of material used
- Criteria for road implementation and maintenance methods
- Control and supervision criteria
- Juga Dari Syarat-Syarat Berlalu Lintas Di Jalan Harus Memperhatikan Beberapa Kriteria Yang Telah

- *Ditentukan Dalam Manual Desain Perkerasan Jalan No. 02/M/BM/2017 Diantaranya Adalah:*

✓ Climate and weather criteria
✓ Average daily traffic and road use load designation criteria
✓ Road user safety and comfort criteria.

➢ *Analytic Hierarchy Process (AHP) Method*

AHP has been successfully used in various fields and disciplines. Its ability to handle qualitative and quantitative data makes AHP an ideal methodology for some prioritisation problems

[15] The AHP (Analytic Hierarchy Process) method is a decision support model developed by Thomas L. Saaty, a mathematician working at the University of Pittsburgh in the United States in the early 1970s. AHP has proven to be one of the most widely applied multi-criteria decision making methods as reviewed by [16]

The AHP method is a decision-making method that uses factors of logic, intuition, experience, knowledge, emotion, and taste to be optimised in a systematic process, and is able to compare in pairs things that are not palpable and palpable, quantitative and qualitative data. The AHP method is also a general theory of measurement used to derive a ratio scale from several pairwise comparisons that are discrete or continuous (Saaty, 1980 in Setiawan, 2003).

## III. RESEARCH METHODS

The method applied in this study is the survey method, the survey method is a primary data collection method by obtaining directly from the research field source. Usually, data or information collection and field facts are directly collected through questionnaires and interviews, both oral and written, which require face-to-face contact between the researcher and the respondent (subject). [17]

➢ *Data Collection Methods*

The data collection technique used is divided into two. first, the primary data collection technique is data obtained directly through the interview/questionnaire method to

respondents who have been selected purposively or in other words, the respondents selected are respondents who are technically considered to know the problems regarding the research conducted by the author. the respondents selected came from technical agencies, namely elements of the Palu City public works office, highways and spatial planning of central sulawesi province, housing and settlement elements that handle neighbourhood roads, national road implementing elements, academics and road and bridge practitioners who have more than 10 years of experience. secondary data was obtained from relevant technical agencies.

➢ *Data Analysis Method*

The variables used in this research consisted of criteria/considerations that became the background of the priority selection of pavement types in Palu city. The criteria used in determining priorities were identified through literature, literature review and references from similar studies that have been conducted previously. In this research, the preparation of the hierarchy level used in the Analytical Hierarchy Process (AHP) method consists of 3 (three) levels, namely:

- Level 1 (objective), is to determine the appropriate and most ideal type of pavement in Palu City road rehabilitation works.
- Level II (criteria) consists of several criteria in determining the prioritisation of road pavement types. these criteria are: technical aspect, cost aspect, implementation aspect, policy aspect.
- Level III (development of level II, hereinafter referred to as sub-criteria), the technical aspect sub-criteria consist of: vehicle load, traffic volume/LHR, service life, safety and comfort, while the cost aspect sub criteria consist of: material costs, equipment costs, labour costs, post FHO maintenance costs, then the implementation aspect sub criteria consist of: use of materials, use of equipment, and use of human resources or labour, and the policy aspect sub criteria consist of: proposal of regional development planning meetings, proposal of main points of thought from members of the regional representative council of Palu City. The criteria and variables used in this study are considered representative in fulfilling the objectives by considering the technical aspects of road handling, the cost aspects of road works, the implementation aspects of road works and the policy aspects that indirectly affect the planning of road works.
- Level IV (Development of Level III, hereinafter referred to as sub-sub criteria), Unlike other criteria, the criteria or policy aspects have sub- sub criteria as intermediaries so that the hierarchy can be formed so that alternative pavement selection can be determined.
- Level V is an alternative type of pavement (surface layer), namely: AC-WC (Asphalt Concrete Wearing Course), HRS (Hot Rolled Sheet), macadam penetration layer, sand sheet, Rigid Pavement and Composite Pavement.

➢ *The Hierarchical Structure in this Study is as follows:*

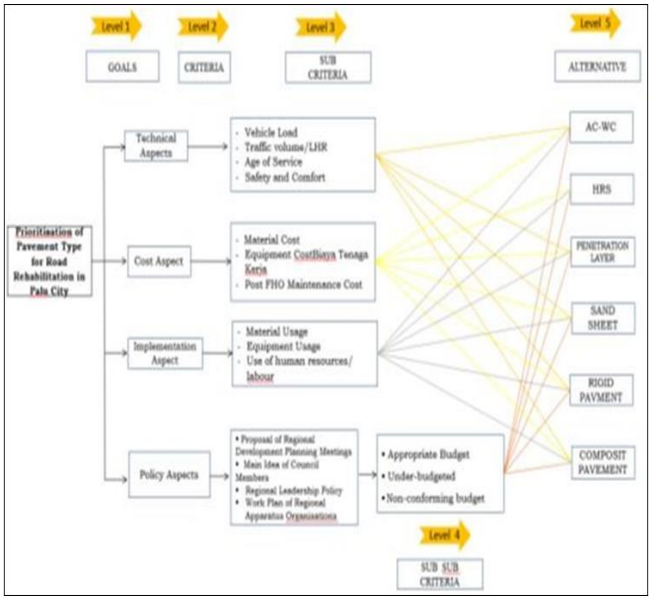


Fig 1 AHP Hierarchical Structure for Road Pavement Type Selection Analysis

## IV. RESULTS AND DISCUSSION

This research uses the Analitycal Hierarchy Process (AHP) method. AHP is used to determine the weight of 4 predetermined criteria including technical aspects, cost aspects, implementation aspects and policy aspects. In each criterion there are sub-criteria which are also weighted to determine which sub- criteria in each criterion are most influential in determining the type of pavement. The Analitycal Hierarchy Process (AHP) in this study was carried out based on the characteristics of respondents who understand and are experts in the field of roads and have experience in planning and implementing road works. In this research, researchers took 12 (twelve) respondents who were considered experts and had more than 10 years of experience in the field of roads and bridges in various agencies.

The first step is to calculate the priority weight of each criterion from the assessment given by all respondents (12 respondents) in determining the priority type of pavement. The results of Analitycal Hierarchy Process (AHP) processing are as follows:

➢ *Comparison between Criteria*

The order of the priority weight of the criteria for the priority selection of pavement types is that the technical criteria have the highest weight of 0.344, then the policy criteria have the second highest weight value with a weight value of 0.247, in third place is the cost criteria with a weight value of 0.230 and the last is the implementation criteria with a weight value of 0.178. The Inconsistency ratio value on these criteria is 0.00352 which shows that the Analitycal Hierarchy Process (AHP) results are acceptable because the inconsistency ratio value is less than 0.1 or less than 10%. The results of data processing can be seen in the following table:

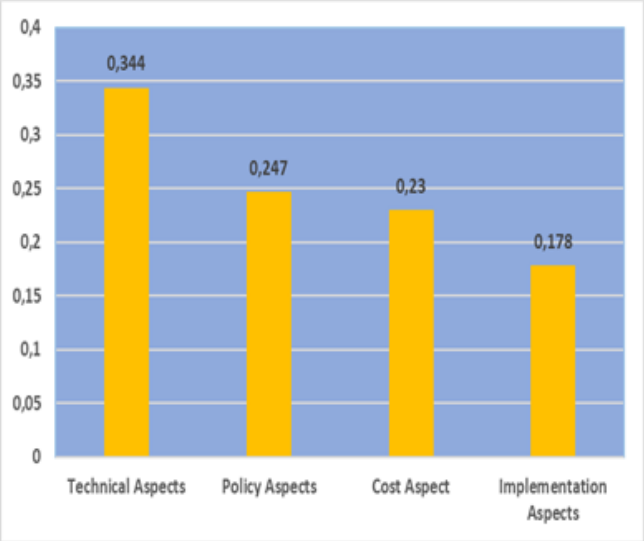


Fig 2 Relative Importance Weight between Criteria
Source: Primary Data Analysis Results, 2023

➢ *Comparison of Technical Sub Criteria*

Based on the results of the weight analysis of sub criteria (technical) using expert choise 11 software, the priority scale of technical sub criteria that influence the determination of the selection of pavement types is as follows: The first sub criteria weight is the vehicle load with a weight value of 0.322, then the second is the volume of traffic / LHR with a weight value of 0.278, for the next service life occupies the third position with a weight value of 0.227 and finally the safety and comfort sub criteria with a weight value of 0.163. The results of the comparison between sub criteria from technical aspects can be seen in the following figure:

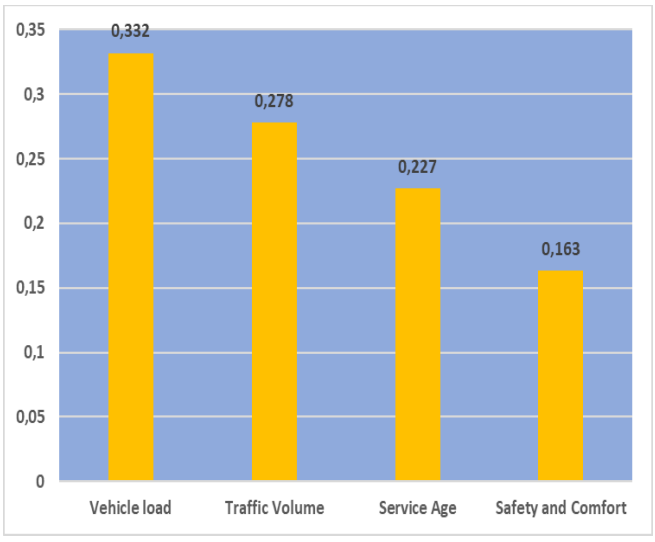


Fig 3 Relative Importance Weight between Technical Sub Criteria
Source: Primary Data Analysis Results, 2023

➢ *Comparison of Cost Sub Criteria*

In the results of data processing using expert choise software version 11, the priority of the cost sub- criteria that influence the determination of pavement type selection can be seen in the following figure:

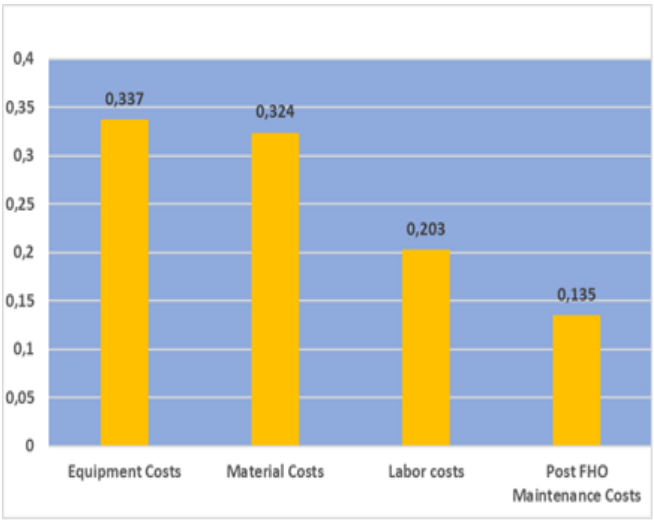


Fig 4 Relative Importance Weight between Cost Sub Criteria
Source: Primary Data Analysis Results, 2023

➢ *Comparison of Implementation Sub Criteria*

In the results of data processing using expert choise software version 11, the priority of the implementation sub-criteria that influence the determination of pavement type selection can be seen in the following figure:

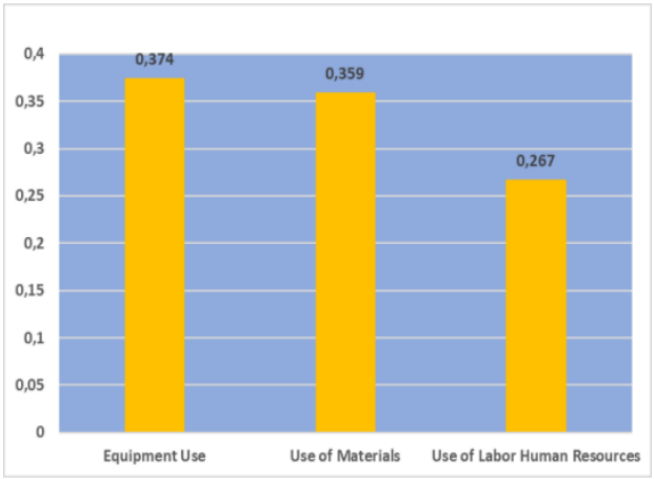


Fig 5 Relative Importance Weight between Implementation Sub Criteria
Source: Primary Data Analysis Results, 2023

From the figure above, it can be seen that the weight of the sub criteria that influence the priority of pavement types for the implementation sub criteria, namely, first is the use of equipment with a weight value of 0.359, then the second is the use of materials with a weight value of 0.324, and finally is the use of human resources (HR) with a weight value of 0.267 with an Inconsistency ratio value on these sub criteria is 0.0024 which shows that the results of the Analitycal Hierarchy Process (AHP) are acceptable because the Inconsistency ratio value is less than 0.1.

➢ *Comparison of Policy Sub Criteria*

In the results of data processing using expert choise software version 11, the priority scale of the influential policy sub criteria in determining the selection of pavement types can be seen in the following figure:

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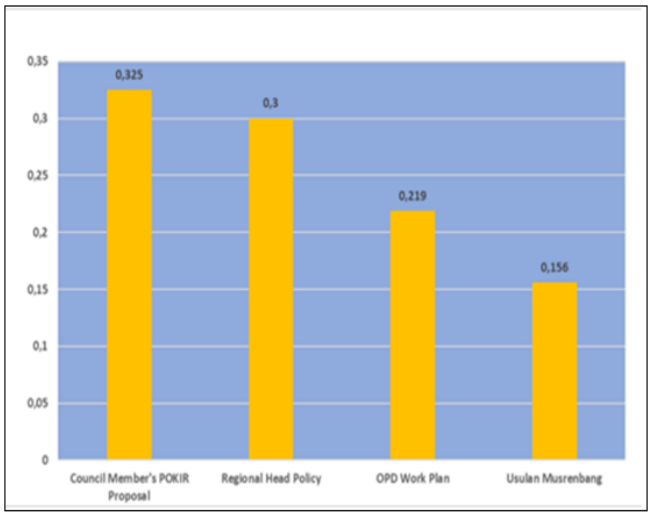


Fig 6 Priority of Policy Sub-Criteria on Priority Selection of Pavement Types
Source: Primary Data Analysis Results, 2023

From the figure above, it can be seen that the weight of sub-criteria that influence the priority of pavement types for policy sub-criteria, namely, road rehabilitation proposals originating from board members through the main ideas are in the first place with a weight value of 0.325, then the second is the road rehabilitation proposal originating from the regional head with a weight value of 0.300, then in third place is the work plan of Regional Apparatus Organization) with a weight value of 0.219 and in fourth place is the proposal for road rehabilitation work originating from regional development planning meetings with a weight value of 0. 156, where the Inconsistency ratio value on these sub- criteria is 0.01 which shows that the Analitycal Hierarchy Process (AHP) results are acceptable because the Inconsistency ratio value is less than 0.1.

- *Alternative Pavement Types based on Technical Criteria/Aspects*

Vehicle load, traffic volume/LHR, service life and safety and comfort become sub criteria of technical aspects, which affect the priority of pavement type selection. Based on the technical aspects of alternative priority pavement types can be seen in the following figure:

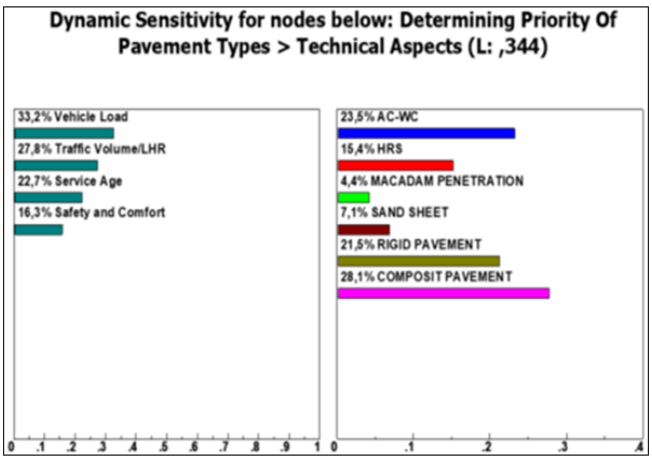


Fig 7 Alternative Prioritisation of Pavement Type Selection based on Technical Aspects

From the figure above, the priority order of pavement alternatives based on technical criteria is obtained, namely: the Composit Pavement pavement type becomes the first priority alternative pavement type with a percentage of 28.1%, this shows that this type of pavement is considered the most reliable in carrying vehicle loads with a high level of traffic volume and has a long service life and has a fairly good level of comfort and safety. Furthermore, the second priority order is the AC- WC (Asphalt Concrete Wearing Course) pavement type with a weight value of 23.5%, this type of pavement is slightly superior to rigid pavement because it has a better level of comfort and safety. In the third order of priority for the selection of pavement types is Rigid Pavement with a percentage of 21.5%, this type of pavement is superior to HRS because it is better at carrying vehicle loads with high vehicle volumes or LHR and has a relatively longer service life. HRS (Hot Rolled Sheet) pavement type is the fourth priority alternative pavement type with 15.4%, this type of pavement is slightly better than sand sheet because it is superior in carrying vehicle loads and traffic volumes, has a longer service life, and a better level of comfort and safety. in the fifth place for alternative priority selection of pavement types is sand sheet with a percentage value of 7.1% and the last is the type of macadam penetration layer pavement with a percentage value of 4.4%.

- *Alternative Pavement Types based on Cost Criteria/Aspects*

Material costs, equipment costs, labour costs and post FHO (Final Hand Order) maintenance costs are sub-criteria from the cost aspect that can affect the priority of pavement type selection. Based on the cost aspect, the alternative priority of pavement types can be seen in the following figure:

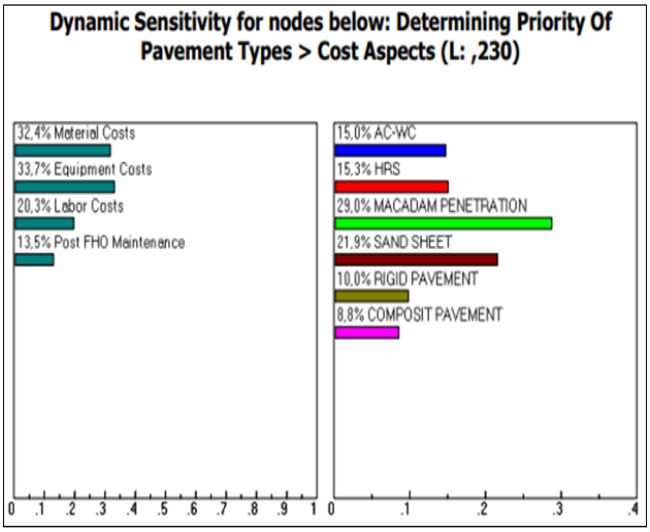


Fig 8 Alternative Prioritisation of Pavement Type Selection based on Cost Criteria/Aspect

From the figure above, the macadam penetration layer pavement type is the first priority in the priority selection of pavement types with a percentage value of 29%, this is because is considered the cheapest pavement type both from material costs, equipment costs and labour costs compared to other pavement types. Furthermore, the second order is

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sand sheet / sand sheet with a weighted value of 21.9%, this shows that from the cost aspect this type of pavement is still cheaper than the HRS (Hot Rolled Sheet) pavement type, in the sand sheet / sand sheet work the equipment used is a maximum of 3 types of tools such as, motor greader to form the road body and spread the maerial, then the vibrator roller for compaction of the foundation layer (LPB / LPA) and tandem roller to compact the main stone and locking stone and to compact the sand sheet mixture. Furthermore, the HRS (Hot Rolled Sheet) pavement type, ranks third in determining the priority of pavement types with a weight value of 15.3%, this shows that this type of pavement is still cheaper than AC-WC (Asphalt Concret Wearing Course), in principle the construction cost between HRS (Hot Rolled Sheet), and AC-WC (Asphalt Concret Wearing Course) is not too significant but this type of pavement is still cheaper, this is due to the minimum thickness for HRS is 3 cm while the minimum thickness for AC- WC is 4 cm (Technical specifications 2018 revision 3). The AC-WC (Asphalt Concret Wearing Course) pavement type then ranks fourth in the priority selection of pavement types with a weight value of 15.0%, this type of pavement is cheaper than rigid pavement, based on the results of research by Nuriadi, Dino (2020) on comparative analysis of highway pavement costs between flexible pavement and rigid pavement, it is concluded that flexible pavement can save 35.55% of costs. Furthermore, in fifth place in the priority selection of pavement types is rigid pavement with a weight value of 10% or a difference of 1.2% from Composite Pavement which ranks last or sixth in the priority selection of pavement types with a weight value of 8.8%, this is because construction costs on composite pavement work, especially on material costs, equipment costs and labour costs are more expensive than rigid pavement.

- *Alternative Pavement Types based on implementation Criteria/Aspects*

There are three sub-criteria from the implementation aspect, namely, the use of materials, the use of equipment and the use of human resources or labour. Based on the results of AHP data processing using expert choise software version 11, the results are as shown below:

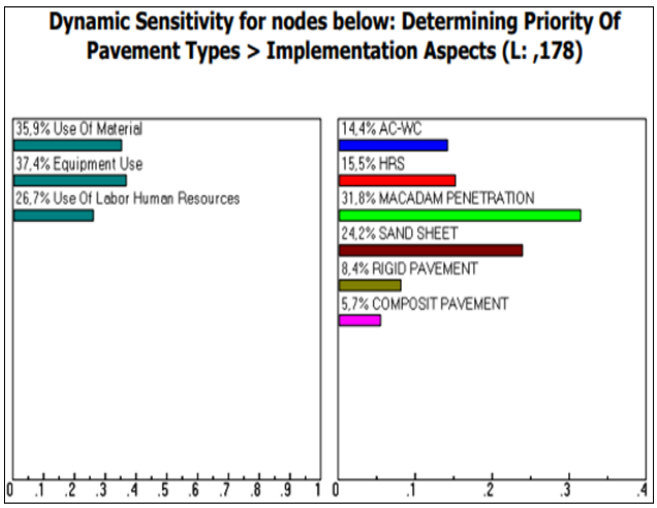


Fig 9 Alternative Prioritisation of Pavement Type Selection based on Implementation Criteria/Aspects

In Figure 9 above it can be seen that the macadam penetration layer pavement type is the first order in the priority selection of pavement types with a weight value of 31.8%, this is because macadam penetration layer is considered the easiest type of pavement from the aspect of implementation, the use of simple materials and equipment and can be done by skilled workers and does not require experts. Then in the second order of priority of pavement types based on the implementation aspect is the type of sand sheet pavement with a weight value of 24.2%, just like macadam penetration layer the type of sand sheet pavement is a type of pavement that is relatively easier to implement compared to other types of pavement such as HRS and AC-WC, because in terms of the use of tools this type of pavement only uses a few main tools such as motor greader, vibrator roller and tandem roller, while for overlaying the latrine material can be done manually.

Furthermore, the HRS (Hot Rolled Sheet) pavement type is in third place with a weighted value of 15.5% or 1.1% different from the AC-WC (Asphalt Concret Wearing Course) pavement type which is in fourth place with a weighted value of 14.4%, both types of pavement are almost the same in terms of the use of equipment and labour and only differ in the use of materials, especially in the composition of the mixture, The HRS mix uses a gap graded aggregate composition where the size of the aggregate is incomplete or there is a fraction of the aggregate that is missing or very small in number with the use of asphalt or relatively higher asphalt content compared to AC-WC (Asphalt Concret Wearing Course).

Then the next order of priority for the selection of pavement types is rigid pavement with a value weight of 8.4%, this type of pavement requires close supervision in terms of material selection so as to obtain concrete quality in accordance with the plan, as well as the use of equipment such as concrete mixers, concrete vibrators and concrete pumps must be ensured to function properly, it also requires skilled and expert personnel and experienced in rigid pavement work. Furthermore, in the last order in the order of priority for the selection of pavement types is composite pavement with a value bobon of 5.7%, this type of pavement is a combination of rigid pavement (rigid pavement) with flexible pavement (flexible pavement) and is more often used on expressways or toll roads (Tax on location). When considering the implementation aspect, this type of pavement falls into the category of complex work and requires skilled labour and experts in the field of roads and bridges, so this type of pavement is still very little applied in Palu City.

- *Alternative Pavement Types based on Policy Criteria/Aspects*

Unlike the other criteria, the criteria or policy aspects have sub-criteria as intermediaries so that the hierarchy can be formed so that alternative pavement choices can be determined. In the policy criteria, there are four sub-criteria, namely, regional development planning meetings proposals, proposals for the main ideas of members of the people's representative council (main idea of council members),

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regional head policy proposals and proposals from the work plan of regional apparatus organisations. As for the sub-sub criteria that become the third level of the hierarchy of policy aspects that become intermediaries where three budget allocation conditions are needed, namely appropriate budget conditions where the budget needs for Palu city road rehabilitation are in accordance with the available budget, then inappropriate budget conditions where the available budget is 75% of the budget requirements for Palu city road rehabilitation work. Furthermore, the budget condition is not appropriate where the available budget is only 50% of the total budget requirement for road rehabilitation in Palu city. Based on the results of AHP data processing using expert choise software version 11, the results are as shown below:

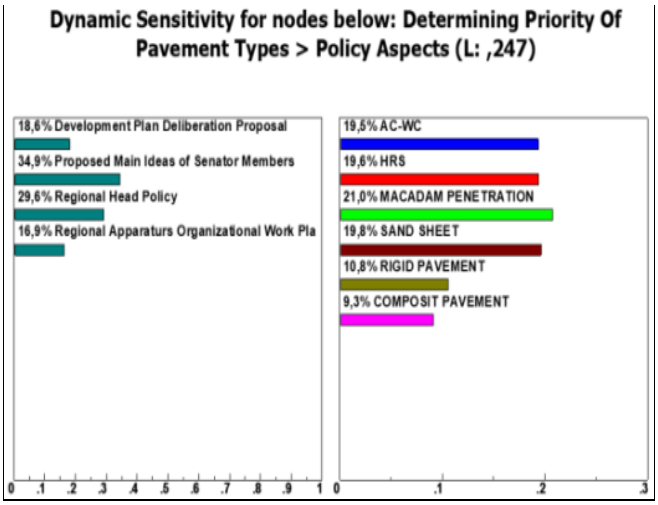


Fig 10 Alternative Prioritisation of Pavement Type Selection based on Policy Criteria/Aspects

In the figure above, it can be seen that the alternative type of pavement that is the first priority based on criteria or policy aspects is the macadam penetration layer pavement type with a weighted value of 20.9%, this is because macadam penetration layer is considered the cheapest type of pavement, easy to work on and does not require too many labour resources and equipment, so it can accommodate more road repair proposals from the community. Furthermore, sand sheet pavement type ranks second with a weighted value of 20.7%, this type of pavement is also relatively cheaper and easier to work on. In the third order of priority selection of pavement types is the HRS (Hot Rolled Sheet) pavement type with a weight value of 19.6% followed by AC-WC (Asphalt Concret Wearing Course) pavement in fourth place with a weight value of 18.2% while Rigid Pavement and Composite Pavement pavement types are in fifth and sixth place with a weight value of 11.0% and 9.5% respectively.

- *Alternative Pavement Types based on Policy Sub Criteria (Regional Development Planning Meetings Proposal)*

Alternative selection of road pavement types based on Regional development planning meetings proposals Alternative selection of road pavement types based on the results of Regional development planning meetings proposals can be seen in the figure below:

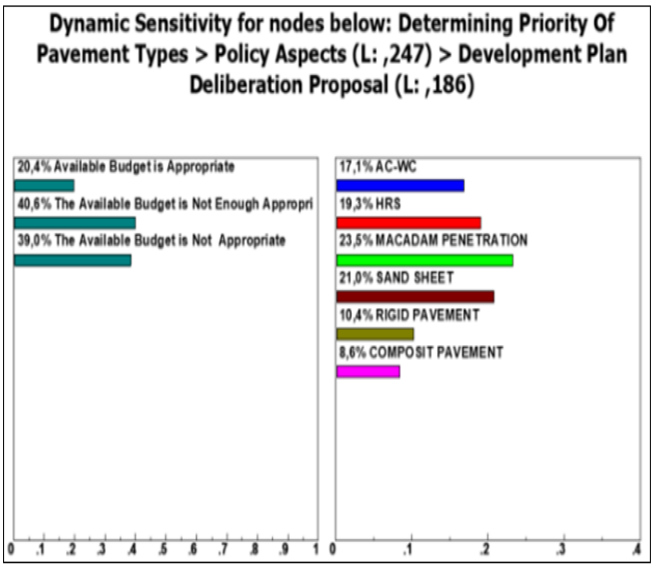


Fig 11 Alternative Prioritisation of Pavement Type Selection based on Policy Sub-Criteria (Regional Development Planning Meetings)

In the figure above, it can be seen that the pavement type macadam penetration layer is an alternative type of pavement that is the first priority based on the sub-criteria of the regional development planning meetings proposal with a value of 23.9%, then the type of sand sheet pavement ranks second with a weighted value of 21%, in third place is the HRS (Hot Rolles Sheet) pavement type with a weighted value of 19.3%. The AC-WC (Asphalt Concret Wearing Course) pavement type becomes the fourth alternative selection of pavement types with a weighted value of 17.1%. The fifth and sixth priorities for the selection of pavement types based on the sub-criteria of the Pokir proposal of the Board Members are Rigid Pavement with a weight value of 10.4% and Composite Pavement with a weight value of 8.9%.

- *Alternative Pavement Types based on Policy Sub-Criterion (Council Member's Pokir Proposal)*

The large number of proposed road sections that must be accommodated through the policies of members of the council (Pokir) is hampered by the availability of the budget, as shown in Figure 4.11 where the average respondent stated that 40.9% of the budget availability each year was considered less appropriate or less than ideal and 39.2% stated that the budget was not appropriate or not ideal. This is certainly very influential on the alternative selection of pavement types. From the results of AHP data processing using expert choise software version 11, the results are as shown below:

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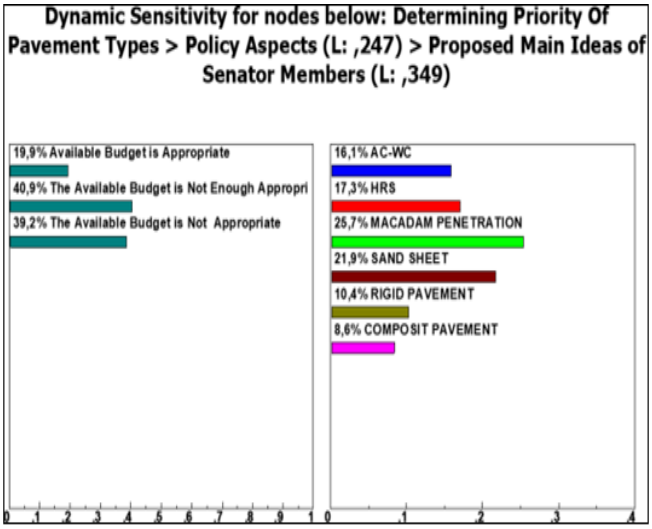


Fig 12 Alternative Prioritisation of Pavement Type Selection based on Policy Sub-Criteria (Proposed Pokir by Council Members)

In the figure above, it can be seen that the alternative type of pavement that is the first priority based on the Pokir proposal sub-criteria of council members is the macadam penetration layer pavement type with a value weight of 25.7%, this is because macadam penetration layer is the cheapest and easiest type of pavement and in terms of relatively short work implementation time, so it can accommodate more road repair proposals from the community. Furthermore, the type of sand sheet/sand sheet pavement ranks second with a weighted value of 21.9%, this type of pavement is also relatively cheaper and easier to work on. Next in third place is the HRS (Hot Rolles Sheet) pavement type with a weighted value of 17.3%, this type of pavement has high durability but has low stability and construction costs are still relatively cheaper than the AC-WC (Asphalt Concret Wearing Course) pavement type. The AC-WC (Asphalt Concret Wearing Course) pavement type becomes the fourth alternative selection of pavement types with a weighted value of 16.1%. The fifth and sixth priorities for the selection of pavement types based on the sub-criteria proposed by the Pokir Board Members are Rigid Pavement with a weight value of 10.4% and Composite Pavement with a weight value of 8.6%.

- *Alternative Pavement Types based on the Policy Sub-Criterion (Regional Leadership Policy)*

The order of alternative types of pavement based on the sub-criteria of regional leadership policies is, first, the type of AC-WC (Asphalt Concret Wearing Course) pavement with a weight value of 22.9%, then the type of HRS (Hot Roller Sheet) pavement sheet ranks second with a weight value of 21.0%. The third priority is the type of latrine/sand sheet pavement with a weight value of 17.6%.

Macadam penetration layer pavement type is the fourth priority with a weight value of 16.4%. Furthermore, the fifth priority is the Rigid Pavement pavement type with a weight value of 11.4% and the Composite Pavement pavement type is the sixth or last priority with a weight value of 10.7%. The order of alternative road pavement types based on regional leadership policies can be seen in the figure below:

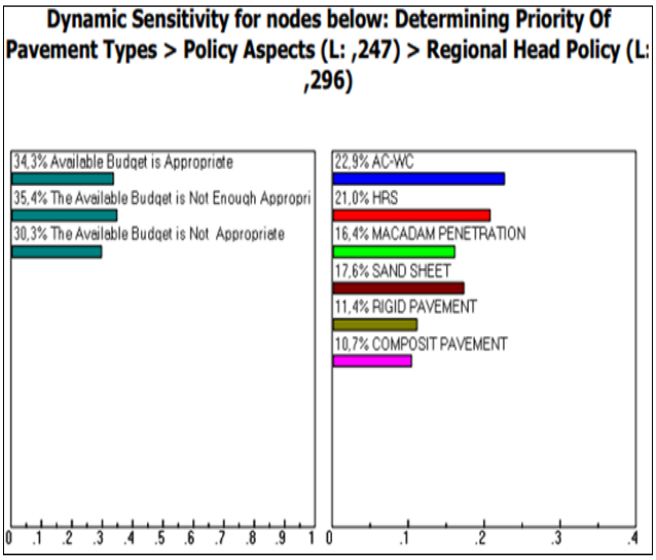


Fig 13 Alternative Prioritisation of Pavement Type Selection based on Policy Sub-Criteria (Regional Head Policy)

- *Alternative Pavement Types based on Policy (Regional Apparatus Organisation Work Plan) Sub Criteria*

The weighting results of alternative pavement type selection based on the Regional Apparatus Organisation work plan obtained the following results: AC-WC (Asphalt Concret Wearing Course) pavement type is the first priority with a weight value of 23.2%. The second priority is HRS pavement type with a weight value of 21.7%. Furthermore, the Sand sheet pavement type is the third priority with a weight value of 18.2%, the fourth priority is the pavement type with a weight value of 16.9%. then Rigid Pavement is the fifth priority pavement type with a weight value of 10.7% and the last priority is the composite pavement type with a weight value of 9.2%. The results of alternative weighting of pavement type selection based on the work plan of the Regional Apparatus Organisation can be seen in the following figure:

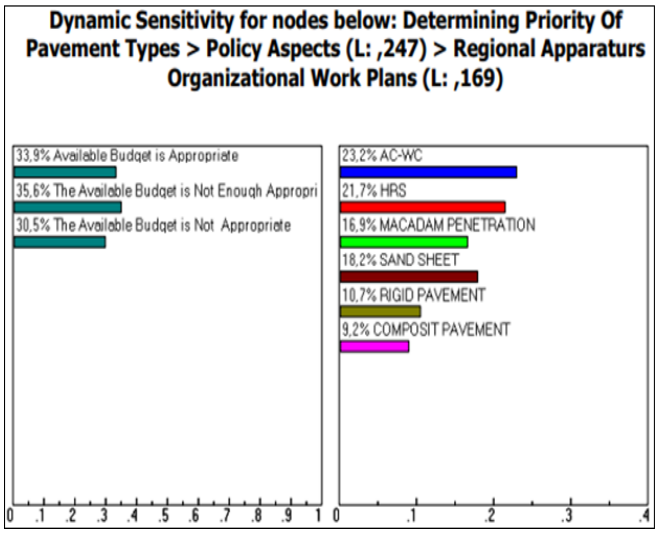


Fig 14 Alternative Prioritisation of Pavement Type Selection based on Policy Sub Criteria (Regional Apparatus Organisation Work Plan)

➢ *Overall Pavement Type Alternatives*

Alternative prioritisation of pavement type selection as a whole is the final result and is the goal of the hierarchy compiled. The sequence of alternative pavement types for road rehabilitation in Palu city is as follows: AC-WC (Asphalt Concret Wearing Course) pavement type is the first priority with a weight value of 19.2%. The second priority is the macadam penetration layer pavement type with a weight value of 18.5%. Furthermore, the HRS (Hot Rollers Sheet) pavement type is the third priority with a weight value of 16.5, the fourth priority is the Sand sheet / sand sheet pavement type with a weight value of 16.4%. then Composite Pavement is the fifth priority pavement type with a weight value of 15.4% and the last priority is the Rigid Pavement pavement type with a weight value of 14.1%. The results of weighting alternative pavement type selection as a whole for road rehabilitation in Palu City can be seen in the following figure:

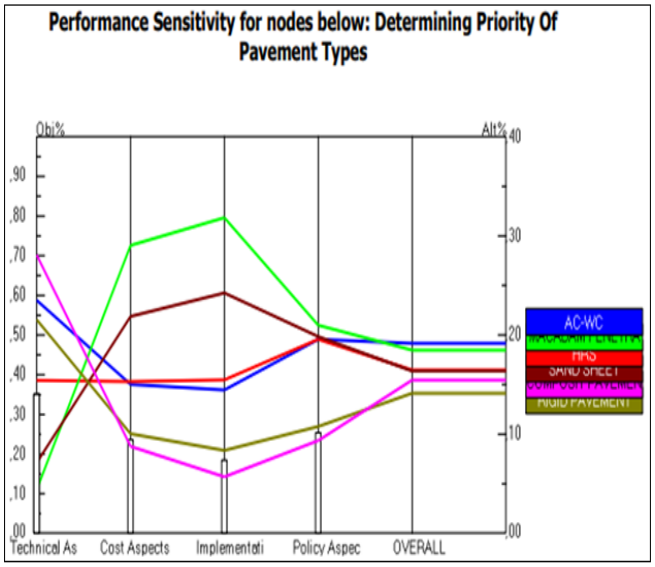


Fig 15 Alternative Prioritisation of Pavement Type Selection for Palu City Road Rehabilitation

## V. CONCLUSIONS AND RECOMMENDATIONS

➢ *Conclusions*

Based on the results of research and discussion, the following conclusions can be drawn:

- The technical aspect is the most influential criterion in the priority selection of road pavement types for road rehabilitation works in Palu City with a relative importance weight of 34.4%, followed by the policy aspect criterion (0.247), then followed by the cost aspect criterion 23.0% and the implementation aspect criterion 17.8%. Meanwhile, vehicle load is the most influential technical sub-criterion in determining the selection of pavement type.
- Alternative priorities for the overall selection of pavement types for road rehabilitation in Palu City resulting from this research are: AC-WC (Asphalt Concret Wearing Course) pavement type 19.2%, macadam penetration layer) pavement type 18.5%. HRS (Hot Rollers Sheet) pavement type 16.5%, Sand sheet/sand sheet pavement type 16.4%), Composite Pavement pavement type 15.4% and Rigid Pavement pavement type (14.1%).

➢ *Recommendation*

Rom the results of the analysis and conclusions, several recommendations can be given as follows:

- There is a need for special regulations and policies related to budgeting for road maintenance costs in Palu City, this is related to the amount of road maintenance currently not proportional to the condition of the road damage level.
- It is necessary to apply the AHP (Analitycal Hierarchy Process) method to policy makers, especially for road managers and council members, where through this method policy making can be more measurable and objective.

## REFERENCES

[1]. S. Burningham and N. Stankevich, “TRANSPORT NOTES Why road maintenance is important and how to get it done,” 2005.

[2]. S. Sayadinia and M. A. Beheshtinia, “Proposing a new hybrid multi-criteria decision-making approach for road maintenance prioritization,” *International Journal of Quality and Reliability Management*, vol. 38, no. 8, pp. 1661–1679, 2020, doi: 10.1108/IJQRM-01-2020-0020.

[3]. F. Tang, T. Ma, J. Zhang, Y. Guan, and L. Chen, “Integrating three-dimensional road design and pavement 1 structure analysis based on BIM,” 2020.

[4]. M. Mahanpoor, S. Monajjem, and V. Balali, “Sustainable highway maintenance: Optimization of existing highway vertical alignment considering pavement condition,” *Sustainability (Switzerland)*, vol. 11, no. 6, 2019, doi: 10.3390/su11061659.

[5]. S. Sukirman, *Perkerasan lentur jalan raya*. Nova, 1999.

[6]. S. Sukirman, *Perencanaan Tebal Struktur Perkerasan Lentur*, vol. 53, no. 9. 2010.

[7]. H. Al-Ajami, “Pavement maintenance management systems,” vol. 7, no. 5, 2015, [Online]. Available: www.iiste.org

[8]. E. Hermans, F. Van den Bossche, and G. Wets, “Combining road safety information in a performance index,” *Accid Anal Prev*, vol. 40, no. 4, pp. 1337–1344, Jul. 2008, doi: 10.1016/j.aap.2008.02.004.

[9]. H. Al-Ajami, “Pavement maintenance management systems,” vol. 7, no. 5, 2015, [Online]. Available: www.iiste.org

[10]. S. Tsigdinos and T. Vlastos, “Exploring ways to determine an alternative strategic road network in a metropolitan city: A multi- criteria analysis approach,” *IATSS Research*, vol. 45, no. 1, pp. 102–115, Apr. 2021, doi: 10.1016/j.iatssr.2020.06.002.

[11]. S. Sukirman, *Perkerasan lentur jalan raya*. Nova, 1999.

[12]. L. R. Vásquez-Varela and F. J. García- Orozco, "An overview of asphalt pavement design for streets and roads Descripción general del diseño de pavimentos asfálticos para calles y carreteras Keywords", doi: 10.17533/udea.redin.
[13]. George. Rechnitzer, Narelle. Haworth, Naomi. Kowadlo, and Monash University. Accident Research Centre., *The effect of vehicle roadworthiness on crash incidence and severity*. Monash University, Accident Research Centre, 2000.
[14]. H. Susanto, S. Negeri, D. Selatan, K. H. Sungai, and S. Kal-Sel, "Faktor-Faktor Yang Mempengaruhi Kinerja Guru Sekolah Menengah Kejuruan The Factors Of Affecting The Performance Of The Teachers' Of State Vocational High School."
[15]. Epigmenio Gonzalez *et al.*, "An AHP- based Approach to Prioritizing Resources for Highway Routine Maintenance (Report 0-6623-2)," 2012. [Online]. Available: www.ntis.gov.
[16]. O. S. Vaidya and S. Kumar, "Analytic hierarchy process: An overview of applications," *Eur J Oper Res*, vol. 169, no. 1, pp. 1–29, Feb. 2006, doi: 10.1016/j.ejor.2004.04.028.
[17]. R. Ruslan, *Metode Penelitian Public Relations dan Komunikasi,*. Raja Grafindo Persada, 2004.